

(begin edit) DESCRIPTION OF THE PREFERRED EMBODIMENT

An optical printed circuit board with electrical connections in the Z axis and optical connections in the X and Y axis according to the present invention is described in greater detail below. For the purposes of this embodiment, the Z axis of the printed circuit board is the direction through the printed circuit board layers that the via holes pass through and is typically very thin, as an example thickness ranges from .002 inches to .5 inches are not uncommon. The X and Y dimensions are the dimensions of the surface of the printed circuit board or "PCB" which are typically the approximate size of the internal layers as well. Many different embodiments may be incorporating the same PCB features described. Types of devices used, layer count, line width, layer thickness, types of holes used or methods of manufacture are all examples of variations that may occur to the PCB without changing the basic application of the current invention.

Referring to Figure 1 the PCB shown has an internal capacitor layer, preferably a power ground 13 sandwich with a thin dielectric core. Formed upon this core are the devices used to generate and receive optical information, usually as high speed pulses. These devices 17, may be existing devices such as laser, LED or newer organo-metallic or other devices. They may include known devices as photodetectors for receiving elements or may be composed of other materials that will perform the same task. These devices will transmit and receive electrical signals from the surface devices 11, which are devices such as BGA, CGA or other such digital or analog processing devices. An advantage of the present invention is the reduction of electrical noise generated by the optical devices, as well as the general reduction of electrical noise generated by the digital portion of the PCB as noted in US Patents 5,079,069 and 5,155,655 both to

Howard et al. Additionally, the preferred embodiment views the mounting of these devices on the conductive layer, most preferably copper as a good method of removing heat from the devices due to the large amount of a very good heat conductive material in the copper plane.

The optical transmission element 18 may be formed through processing through several different methods or may be a premade optical fiber which may be incorporated on the layer during the manufacturing of the PCB. Some of the manufacturing methods may include etching paths in the copper foil on the surface 13 of the capacitor layer, then filling the paths with an optically clear material and curing that material to provide stability. Optical fibers may be secured in the etched paths or on the surface of the copper or other conductive material to accomplish the same task. The etched paths may be formed as open channels with no filler material, or filled with gas or vacuum to promote optical clarity. It may be advantageous in the most preferred embodiment to only partially etch through the conductive surface to provide an optically reflective channel on three sides, which may be fully encapsulated with a reflective surface on the top surface to completely enclose the light transmissive channel. It is fully contemplated within the preferred embodiment that a highly internal surface is preferable within the light transmissive channels, which are formed in or on the conductive surface. All these methods are contemplated within the current invention.

14 and 15 show additional common circuit elements of copper and dielectric material, which further compose the PCB. This construction method may include the method of using resin coated copper or "RCC" to facilitate the use of laser or other processing to form the via holes 16 in the most preferred method. Additionally, 12 shows

a common connection method of assembly using solder balls to connect device 11 to pad 19.

16 shows a blind via which connects the surface pad 19 electrically to the optical transmission and reception elements 17. Utilizing the shortest and most inductance free method of connection between the surface device and the optical elements is considered to be the most preferred embodiment of the current invention. It is one preferred embodiment of the current invention to use conductive polymer as a method of forming the conductive via hole. This method will allow greater process flexibility in the types of interconnection methods that may be employed in the final method.

Referring now to Figure 2, this figure shows a top view of the PCB in figure 1 as with surface devices 11 and optical transmission element 18. As is shown 18 may move freely in the X and Y axis of the PCB but does not travel in the Z axis. The key reasons are the impractical nature of 90 degree or greater bending of light within a very unstable polymer structure such as a PCB, and the very short distances that electrical signals must travel in the Z axis in the preferred embodiment in comparison to the travel of light transmission channels in the X and Y dimensions.

Figure 3 shows a schematic side view of the PCB similar to Figure 1 but demonstrating that the optical elements 17,18 may be formed on a different layer 15. This demonstrates the possibility of placing the elements on any layer within the current invention. Connection hole 16 is added to provide the necessary electrical connections to the surface devices. (end edit)